

Running head: EQUIPMENT COST FORECASTING

Cost Forecasting for Equipment during Initial Outfitting:  
A Comparative Analysis among Three Military Services and the  
Private Healthcare Industry

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### Abstract

Planning for the population's healthcare needs of the future is no easy task, but it is the first step in planning for a new medical facility. In this time of budget constraints, it will be a challenge for any organization to determine not only the most appropriate facility design, but also the capital equipment requirements.

The purpose of this study was to determine the accuracy of the Army's current equipment estimation process during initial outfitting through the analysis of historical projects. The analysis revealed that on seven past projects, the Army was within budget on six projects. However, limitations of the study reveal that the results are truly inconclusive due to a small sample size and missing data.

The study also identified variables that may be important in the cost forecasting process but are not currently included in the Army's budgeting methodology. For example, other organizations are including freight, storage, installment, and procurement assistance costs in budget estimates. Inclusion, or at least evaluation of these variables, may provide the possibility of further accuracy during the equipment budgeting process for the Army.

The results lead to an unexpected conclusion that relates more toward a change in procedure than a change in the actual budget estimate figure. The private sector clearly has better data collection methods for tracking equipment planning during construction. The military health system (MHS) must centralize and standardize equipment data collection and reporting in order to conduct any historical or prospective analysis that can be useful in developing budget estimates.

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Introduction

As the healthcare industry as a whole has shifted from inpatient to ambulatory care, the need for large inpatient hospitals has declined leaving many organizations with facilities that are not designed for today's wellness-based approach. In fact, in many hospitals across the country, it is common to see old patient rooms converted into office spaces, reflecting the national decline in inpatient census.

This major change in the delivery of care requires an organization to be strategic in its thinking. Though this is certainly the starting point, it is not enough. "Important as those strategies may be, they'll be tough to implement in buildings designed in the 1950s and '60s" (Borling, 1997, p. 42). Planning the scope of services a hospital chooses to offer will ultimately dictate the type of facility needed and the medical technology or equipment that will go in it. Many organizations have had to renovate existing facilities and/or build new ones, to keep up with the future needs of the patients.

Planning for the population's healthcare needs of the future is no easy task, but it is the first step in planning a new facility. In this time of budget constraints for both public and private sector healthcare, it will be a challenge for any organization to determine not only the most appropriate facility design but also the capital equipment requirements. Most health care administrators agree that to be successful in the industry, they have to "balance the emerging medical technology required to deliver optimum patient care with ever escalating costs associated with the implementation of this new technology" (Barry and Dalton, 1998, p. 1).

#### Conditions which prompted the Study

Though all of this change may be frightening to many healthcare executives, it should not be a signal to stop investing in the organization's facilities. Rather, it should force health care administrators to see that "every dollar spent (during initial outfitting of healthcare facilities) must be carefully planned..." (Borling, 1997, p. 42).

Recognizing this need to have well-designed medical treatment facilities (MTFs) that also meet budgetary constraints, the Army Medical Command (MEDCOM) recently hired a reputable Department of Defense (DoD) contractor to analyze historical equipment costs associated with initially outfitting a new facility (SOW, 1998). The Army MEDCOM believes that the

current budget estimates are inaccurate and result in either unplanned spending or shortfalls that may negatively impact patient services. Through an historical analysis of construction projects, it is thought that revised budget estimates will lead to more accurate equipment cost projections for future construction projects.

Similarly, when querying the other services, Air Force and Navy, it was common to hear the same level of frustration with the current equipment planning procedures, especially cost forecasting. Captain Raymond Swisher, Navy Specialty Leader for Military Construction Liaison Officers (MCLOs), feels that the Navy can not only improve its cost forecasting techniques, but can do more concurrent monitoring of actual project spending (personal communication, Aug 27, 1998). Lieutenant Colonel Roberta Young, Deputy Chief, Health Facilities Division, Air Force Medical Support Activity/Office of the Surgeon General (AFMSA/SGSF), likewise spoke of the inaccuracy of the Air Force's methodology.

Interestingly, none of the services have a true idea of the degree of accuracy in their respective estimates. In fact, none of the services have the data immediately available to calculate the accuracy of each project's equipment budget as reflected in the initial program objective memorandum (POM). Anecdotally, however, it is obvious that these service experts feel strongly

that their methodologies, like the Army's, are in desperate need of improvement.

Currently, the Army, Navy and Air Force have informal service specific procedures for estimating equipment costs for initial outfitting of a facility. However, none of the services have established formal written policy (i.e., instruction, directive, etc.) describing the precise methodology used to derive the percentage estimates. Basically, a percentage of the construction project programmed amount (PA) is used to estimate equipment costs. Typically, this percentage reflects the cost of initially outfitting projects of similar size in previous years. However, none of the services have a sound policy about the frequency for which the percentages should be updated. For example, until a recent update, the Air Force has used the same percentages for over ten years.

A hypothetical example illustrates how this estimation process is applied. If the Army plans to replace a large teaching facility or medical center, (e.g., Brooke Army Medical Center (BAMC)), it estimates 30% of the PA for equipment costs. Therefore, if the cost to construct the new BAMC is \$200 million, the budget for equipment is \$60 million (30% of \$200 million). This \$60 million is in addition to the \$200 million in construction costs. The Navy and Air Force use similar procedures for estimating equipment costs, but the actual

percentages vary. Table 1 delineates the percentages used by each service.

#### Statement of the Problem and Purpose of the Research

The purpose of this study was to determine the accuracy of the Army's current equipment estimation process during initial outfitting through the analysis of historical projects. The study also identifies variables or factors that may be important in the cost forecasting process but are not currently included in the Army's budgeting methodology. Inclusion of these variables, or at least evaluation of these variables, may provide the possibility of more precise estimates during the equipment budgeting process. Additionally, a comparative analysis of the three services' and private sector's equipment cost forecasting methodologies will also provide insight into the accuracy of the Army's process.

Ideally, this study should increase the overall awareness of health care administrators regarding the necessity of effective equipment planning. Though the MHS will probably not be building many new facilities, the requirement to renovate existing structures as they age should continue. Therefore, it is essential that in such times of fiscal constraint, the Military Health System (MHS) be able to accurately predict the cost of initially outfitting MTFs.

**Table 1**  
Service Comparison of Equipment Budgeting during Initial Outfitting

**ARMY**

<b>FACILITY<sup>a</sup> AND PROJECT<sup>b</sup> TYPE</b>	<b>% OF FAC COST<sup>c</sup></b>	<b>OM PORTION OF FAC COST<sup>d</sup></b>	<b>OP PORTION OF FAC COST</b>
MEDCEN Replacement	30%	24%	6%
MEDDAC Replacement	25%	20%	5%
MEDDAC Renewal	25%	22.5%	2.5%
Clinic Replacement	20%	18%	2%
Clinic Renewal	20%	18%	2%
Medical/Dental Clinic Renewal	25%	22.5%	2.5%

**NAVY**

<b>FACILITY TYPE<sup>f</sup></b>	<b>% OF FAC COST<sup>c</sup></b>	<b>OM PORTION OF FAC COST<sup>d</sup></b>	<b>OP PORTION OF FAC COST<sup>e</sup></b>
Teaching Hospital	32%	29%	3%
Hospital	23%	22%	1%
Medical / Dental Clinic	17%	17%	N/A
Medical Clinic	17%	17%	N/A
Dental Clinic	16%	16%	N/A
BEQ/BOQ	15%	15%	N/A
Other	10%	10%	NA
Non Medical / APTU	8%	7.5%	N/A

**AIR FORCE**

<b>PROJECT TYPE<sup>b</sup></b>	<b>% OF FAC COST<sup>c</sup></b>	<b>OM PORTION OF FAC COST<sup>d</sup></b>	<b>OP PORTION OF FAC COST<sup>e</sup></b>
Replacement	19%	9%	10%
Addition/Alteration	17%	9%	7.5%
Life Safety Upgrade (LSU)	14%	9%	5%

- a. As defined by Army Medical Command. MEDCEN = Medical Center, MEDDAC = Medical Department Activity which is typically an Acute Care/Community Hospital, CLINIC = Acute Care Clinic, MED/DENT CLN = Medical/Dental Clinic.
- b. Replacement is building a new structural facility to replace the old; Renewal is renovating an existing structure; addition/alteration is adding a new structure to an existing structure and possibly renovating some of existing structure too; LSU is significant repairs to structure to comply with regulatory requirements such as EPA, OSHA, etc.
- c. The percentage of the facility cost or project amount (PA) attributed to equipment.
- d. The percentage of (c) that is to be funded by the Operations and Maintenance (OM) budget, which represents items less than \$100,000 each.
- e. The percentage of (c) that is to be funded by the Other Procurement (OP) budget, which represents items greater than \$100,000 each.
- f. As defined by the Navy's Bureau of Medicine and Surgery - self explanatory facility type

### Literature Review

Various books have been published that discuss healthcare facility planning. Unfortunately, none of the publications reviewed address the details of cost forecasting which is the real basis of this particular study. Some information is available in the related journal literature that addresses equipment planning, mostly in what is often termed the "replacement and modernization phase." This phase basically means everything after initial outfitting (i.e., normal replacement of equipment and modernization of technology once the new hospital is established). The few articles that do address the initial outfitting stage focus on the overall concept of strategic planning which has become increasingly important in the healthcare industry. "Hospitals have typically initiated construction projects in response to isolated needs, resulting in a patchwork of facilities and services" (Borling, 1997, p. 42).

However, the health care industry now requires a proactive instead of a reactive approach for building or redesigning facilities to meet the future needs of the community (1997). "But market dynamics haven't necessarily killed innovative design and construction. In some locations the themes of preventive care, managed care, and the shift to outpatient care have found an architectural voice" (Appleby, 1995, p. 34). In

reality, organizations must make the transition if they hope to hold on to a piece of the market share.

One of the primary factors that has influenced the industry's need to be better equipment planners is the escalating cost of purchasing and maintaining medical technology. Hospitals that historically purchased only state-of-the-art medical equipment are now rethinking those decisions based on hard evidence derived from cost-benefit and profitability studies (Serb, 1997). Capital resources are scarce and investing in the right equipment is crucial if an institution is to remain viable. Compared to the old days when big-ticket spending was the norm, the penny-pinching that goes on in the capital allocation budgets seems almost absurd. However, changes in healthcare reimbursement, like capitation and resource based relative value system (RBRVS), make cost analyses essential when investing in capital equipment (Cerne, 1995).

Consequently, it is more important than ever that the task of equipment planning during initial outfitting be appropriate, effective, and within budget estimates. Marshall Erdman & Associates (1994) discussed in depth what steps are necessary for organizing, designing and building healthcare facilities. This nationally known firm even provides cost model spreadsheets that organizations may use as a tool for determining budget



requirements for a project. Although all the applicable equipment categories are present, the actual methodology used to derive the budget figures for each equipment category is not. It is this methodology that seems to be somewhat controversial among experts in the field. Unfortunately, very little is published about the current methodologies employed by organizations when determining equipment budgets for initial outfitting. Nonetheless, personal interviews with industry personnel in equipment planning and healthcare facility construction shed some interesting light on the subject.

There are many organizations, including all of the services in the MHS, which determine the initial equipment estimate by using a percentage of the actual construction project programmed amount (PA). Joan Barry, principal of Facility Development, Inc. (FDI), one of the nation's leading equipment planning firms, believes that organizations that use a percentage based estimate, typically use a figure in the range of 30-38% of the PA (personal communication, October 5, 1998).

However, Ms. Barry, along with other recognized leaders in the field, believe that use of percentages is inaccurate and quickly becoming a thing of the past. Rather, as Ted Ritter, owner of Ritter Construction Management, points out, organizations must do the hard work of conducting complete inventories and developing room specific equipment lists "up

front" in the planning process in order to determine an accurate forecast of equipment costs (personal communication, July 15, 1998). In fact, Mr. Ritter, a keynote speaker for the American College of Healthcare Executives (ACHE) on Facility Design and Planning, jokingly says, "Thou shall not use the words 'percentage of (anything)'" in his class. However, he is quite serious when discussing the problems associated with estimating equipment costs based on a percentage of construction costs.

#### Methods and Procedures

Each of the services (Army, Navy and Air Force), as well as two civilian healthcare organizations (Columbia/HCA and Tenet Healthcare Corp.), were researched to determine current methodologies for equipment cost forecasting during initial outfitting. This was accomplished primarily through experience surveys, literature reviews and research of existing policies and regulations governing initial outfitting procedures. A comparison of the three services and the private industry practices was accomplished and specific differences were noted that might impact the accuracy of the cost forecasting procedures. These areas were addressed and revealed compelling reasons for the Army to investigate the variables included in the other cost forecasting methodologies. Only at that time can it be determined if further improvements can truly be made to the Army's forecasting process to increase its accuracy. The

historical project analysis results were evaluated to determine how accurate the Army's estimates actually were for the particular projects. From those results, the study evaluated the potential generalizability of the DoD contractor's recommended changes to the other services.

### Validity and Reliability

Though this study was generally of a qualitative nature, there are still specific measures that were taken to increase reliability and validity. First, multiple sources were sought to verify the information collected and simply to gain a better overall understanding of the military services' and private industry's equipment cost forecasting procedure - beginning with the initial construction planning to the actual opening of the new facility. An additional reference page is provided especially for those interested in studying this area further.<sup>1</sup>

External validity is the ability to generalize recommendations across persons, setting and times (Cooper & Emory, 1995). Since initial outfitting methodologies are similar in nature, meaning there is nothing militarily unique about the MHS, generalizing recommendations about the best

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<sup>1</sup> The references also provide further evidence of reliability as they offer multi-source consistency.

methodology should be easily applicable to military or private sectors. A hospital is a hospital, at least from the standpoint of construction and initial outfitting procedures.

### Study Design

This was a retrospective study designed to evaluate historical project equipment costs and compare and contrast the MHS and private sector methodologies for equipment cost forecasting during initial outfitting. Cooper and Emory (1995, p. 119) clearly point out that "seldom is more than a fraction of the existing knowledge in a field put into writing." This is definitely the case with equipment planning and causes the researcher to seek information from people experienced in this particular area of study. Therefore, this GMP was an exploratory study that relied heavily on the technique of experience surveys (1995). Experience surveys are appropriate in research such as this when very little about the topic is actually in writing. Not only is this the case for equipment planning in general, but even more so for the procedures used by the military services. However, the interviews conducted may provide a more accurate picture of the military system's equipment cost forecasting procedures than an official regulation might since those are often outdated and/or not actually utilized.

### Ethical Issues

The primary ethical issue in this study related to release of proprietary information. In this regard, contributing people were informed of the reason for the interview and asked if inclusion of their comments in the research paper was acceptable. Furthermore, if the person agreed to the interview, they were given the opportunity to review the applicable section of the paper to ensure nothing inappropriate or inaccurate had been said about them or their organization. This is particularly important since organizations from the private sector made contributions to the research. Every effort was made to ensure a level of comfort for those individuals in regard to the sensitivity and security of any proprietary information.

### Results

The primary objective of this study was to determine the accuracy of the Army's equipment cost forecasting process for initial outfitting. Currently, the Army uses a percentage of the PA (i.e., total construction cost) to budget for equipment. Again, these percentages are provided in Table 1, along with the percentage estimates used by the other services. The DoD contractor analyzed data from seven Army medical construction projects, ranging from 1991 to 1998, to ascertain whether the budget percentages used by the Army were accurate. Table 2 reports the results.

Table 2  
Summary of Equipment Costs by Project

FACILITY TYPE <sup>a</sup>	FACILITY NAME <sup>b</sup>	PROJECT TYPE <sup>c</sup>	FACILITY COST <sup>d</sup>	EST EQMT COST <sup>e</sup>	ACTUAL EQMT COST <sup>f</sup>	% OF FACILITY COST <sup>g</sup>		PERCENT BUDGETED <sup>i</sup>
						ESTEQTMT <sup>g1</sup>	ACTEQMT <sup>g2</sup>	
MEDCEN	BAMC	Replacement	\$317,836,800	\$171,129,985	\$118,524,160	53.8%	37.3%	30%
MEDCEN	WAMC	Replacement	\$250,000,000	\$65,494,237	\$55,361,869	26.2%	22.1%	30%
MEDCEN Sum <sup>h</sup>			\$567,836,800	\$236,624,222	\$173,886,029	34.5%	26.7%	30%
MEDDAC	SILL	Replacement	\$125,837,400	\$13,091,545	\$10,846,147	10.4%	8.6%	25%
MEDDAC Sum			\$125,837,400	\$13,091,545	\$10,846,147	10.4%	8.6%	25%
CLINIC	IRWI	Replacement	\$7,307,100	\$1,410,964	\$1,408,262	19.3%	19.3%	20%
CLINIC	TMC2	Replacement	\$3,240,000	\$557,365	\$538,585	17.2%	16.6%	20%
CLINIC Sum			\$10,547,100	\$1,968,329	\$1,946,847	18.3%	17.9%	20%
MED/DEN CLN	HAWA	Renewal	\$22,800,000	\$5,922,407	\$5,065,318	26.0%	22.2%	25%
MED/DET CLN	MCPH	Replacement	\$14,902,940	\$3,295,262	\$2,472,980	22.1%	16.6%	25%
MED/DEN CLN Sum			\$37,702,940	\$9,217,669	\$7,538,298	24.0%	19.4%	25%

- a. As defined by Army Medical Command. MEDCEN = Medical Center, MEDDAC = Medical Department Activity which is typically an Acute Care/Community Hospital, CLINIC = Acute Care Clinic, MED/DENT CLN = Medical/Dental Clinic.
- b. BAMC = Brooke Army Medical Center, Ft. Sam Houston, Texas; WAMC = Womack Army Medical Center, Ft. Bragg, North Carolina; SILL = Reynolds Army Community Hospital, Ft. Sill, Oklahoma; IRWI = Ft. Irwin Ambulatory Care Clinic, Ft. Irwin, California; TMC2 = Consolidated Troop Medical Clinic 2, Ft. Sill, Oklahoma; HAWA = Scofield Barracks Army Health Clinic, Scofield Barracks, Hawaii; MCPH - McPherson Army Health Clinic, Ft. McPherson, Georgia.
- c. Replacement means building a new structural facility to replace the old; Renewal means renovating an existing structure.
- d. FACILITY COST = PA or total dollar amount funded by the military construction (MILCON) appropriation for construction of a particular facility. It does not include any costs for outfitting the facility.
- e. EST EQMT COST = estimated equipment cost is the dollar amount for equipment necessary to outfit the facility assuming no existing equipment would be reutilized. This amount was determined by the contractor for each particular project.
- f. ACT EQMT COST = actual equipment cost is the total dollar amount of equipment that was actually purchased. The difference between estimated (e) and actual (f) is the amount of equipment that was moved over from an existing facility for reutilization.
- g. % of FACILITY COST = The percentage of the facility cost that can be attributed to EST EQMT COST and ACTUAL EQMT COST. Column (e) divided by (d) = column (g1). Likewise, column (f) divided by (d) = column (g2). This is where the actual comparison to budget figures is conducted.
- h. The MEDCEN Sum was a weighted average of WAMC to BAMC 3:1 since a MEDCEN like BAMC is less common.
- i. The percentage of facility cost that the Army MEDCOM initially budgeted for in the planning stages of the project.

Table 2 can be best understood by looking at a specific project. Brooke Army Medical Center (BAMC) is a medical center (MEDCEN) which typically means it is a large tertiary teaching facility with Graduate Medical Education (GME) residency programs. The Army MEDCOM defines the various facility types and determines into which category each hospital or clinic falls. The study only had data from two different project types - replacement and renewal. BAMC is a replacement project, which means a new structural facility was built to replace the old facility; whereas a renewal project means there is an existing structure that will be renovated.

Various other project types exist, such as addition/alteration, Life Safety Upgrade (LSU) and even Heating, Ventilating, and Air-conditioning (HVAC) projects, but were not included in this analysis.

As stated earlier, the PA is the total dollar amount for construction funded by the military construction (MILCON) appropriation. For clarity, this amount is labeled Facility Cost in the table. These figures were obtained from the Army's Health Facility Planning Agency (HFPA) which has oversight of all Army medical construction projects. The Facility Cost is separate and distinct from any money set aside for initial outfitting.

Inflating to 1998 dollars using the Product Price Index (PPI) standardized these figures, as well as all cost figures used in the analysis. This enabled the cross-project cost comparisons necessary for this analysis. The inflation was accomplished by applying equipment type-specific inflation factors to individual equipment categories. The PPI was selected over the Consumer Price Index (CPI) because the CPI medical commodity values reflect household expenditures for health insurance premiums and other costs (Kowal, 1998) not consistent with initial outfitting. Furthermore, the PPI contains specific equipment categories that align easily with the projects' equipment categories. The composite inflation factors applied by project and equipment category are displayed below in Table 3.

Table 3  
Composite Inflation Rates for Equipment Types by Project

Equipment Type	SILL 1991	TMC2 1993	BAMC 1994	MCPH 1995	IRWI 1997	WAMC 1998	HAWA 1998
Administrative	1.33	1.20	1.15	1.12	1.06	1.00	1.00
Computers*	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Dental	1.27	1.19	1.16	1.12	1.04	1.00	1.00
Furniture	1.22	1.14	1.12	1.12	1.06	1.00	1.00
Laboratory	1.21	1.12	1.09	1.05	1.01	1.00	1.00
Medical	1.21	1.12	1.09	1.05	1.01	1.00	1.00
Pharmacy	1.21	1.12	1.09	1.05	1.01	1.00	1.00
Radiology	1.07	1.07	1.05	1.04	1.03	1.00	1.00
Surgery	1.21	1.12	1.09	1.05	1.01	1.00	1.00

\*PPI for computers not calculated until 1995. PPI indicates prices actually dropped significantly each year since 1995; therefore, contractor chose a more conservative approach and simply not apply an inflationary factor (which would actually decrease prices in this case) to the computer category.



The column in Table 2 labeled estimated equipment cost (EST EQMT COST) is the value of equipment reflected in dollars that is necessary to outfit the new facility, assuming no existing equipment will be reutilized. The contractor determined this cost by evaluating the proposed mission of the facility, interviewing key clinical personnel and conducting research on essential equipment technology costs.

The actual equipment cost (ACTUAL EQMT COST) is the dollar amount that was spent on equipment. This figure was obtained from the contractor's databases and the MEDCASE Requirements and Execution (MRE) database at the United States Army Medical Materiel Agency (USAMMA), Ft. Detrick, Maryland. Theoretically, the difference between the estimated and actual equipment costs represents the cost avoidance of reutilizing existing equipment and not having to purchase new items. For example, the estimated equipment cost may reflect the need for 15 ultrasound machines at a unit price of \$15,000.00. However, the existing facility has 5 units in excellent condition with acceptable life remaining. Therefore, the facility's actual equipment cost is \$150,000.00 (10 units x \$15,000.00/ea) for new equipment. The cost avoidance is \$75,000.00.

The percentages of facility cost (% OF FAC COST) were obtained by simple mathematical calculations and represent the true focus of this study. The estimated equipment percentage

(ESTEQMT) of 53.8% for BAMC was derived from dividing the EST EQMT COST of \$171,129,985 by the FACILITY COST of \$317,836,800. This means that 53.8% of the FACILITY COST was required to outfit BAMC. Similarly, the actual equipment (ACTEQMT) percentage of 37.3% was derived from dividing the ACTUAL EQMT COST of \$118,524,160 by the FACILITY COST of \$317,836,800. This means that 37.3% of the FACILITY COST was actually spent to outfit the new hospital. Again, the difference between the two amounts is the cost avoidance. Also recall that the equipment percentages are reported as a percentage of PA (i.e., Facility Cost), but actually means money spent in addition to the PA.

Each project was evaluated independently and then included in a facility type category for summary purposes. For example, Table 2 shows Ft. Irwin (IRWI) and Troop Medical Clinic Two (TMC2) in the CLINIC facility type. Therefore, the Clinic Summary (CLINIC SUM) represents the average of the two projects. With one exception, each of the facility type categories was averaged in this way. The MEDCEN facility type was handled differently because of the extreme differences between the two facilities. Though both BAMC and WAMC are in the MEDCEN category, it would be rare for the Army to build another facility as large and complex in size, service and scope as BAMC. Rather, WAMC is more typical of a MEDCEN. In this case, a straight mathematical average was not considered appropriate

when evaluating the MEDCEN category as a whole. Therefore, the contractor calculated a weighted average of 3:1, WAMC to BAMC, to reflect this difference. The MEDCEN Sum line in Table 2 reflects this weighted average.

Another objective of this study was a comparative analysis of the MHS' and civilian counterparts' cost forecasting methodologies. Tenet Healthcare Corporation and Columbia/HCA, both nationwide healthcare organizations with over 300 (Columbia/HCA, 1999) and 130 (Tenet, 1999) hospitals and related healthcare facilities respectively, agreed to discuss their methodologies. For proprietary reasons, actual project costs were not obtained, therefore, the accuracy of the organizations' forecasting cannot be independently verified. However, the anecdotal information alone speaks volumes about the differences between the services and the private sector and serves as an interesting comparison.

Columbia/HCA, like the MHS, uses a percentage of the facility cost to estimate equipment costs. However, the 45% it uses as an initial budget estimate (Batton, personal communication, August 31, 1998) is far greater than any estimate used by any of the services. The highest estimate used by any of the services is the Navy's 32% for teaching hospitals. In fact, Columbia/HCA's 45% estimate does not even include what Columbia/HCA projects for any information technology (from PC to

servers), which would certainly boost the planning figure significantly.

Columbia/HCA uses the equipment estimate as part of its initial proposal to determine project viability. Once viability is established using the 45%, equipment planners in the construction & design department of Columbia/HCA headquarters begin the work of developing room equipment lists. At various stages, the planning figure of 45% is reevaluated for accuracy. Any unplanned deviation from that estimate may cause equipment planners to rethink their approach. Unlike the military, Columbia/HCA has a centralized database of all projects dating back to the 1970s making historical analysis of projects a simple task.

Comparatively, Tenet Healthcare Corporation never uses a percentage estimate in the planning stage. Rather, once armed with the concept of design (type, size, mission and services of facility), it provides comprehensive equipment lists made possible through use of historical project databases (Campbell, personal communication, September, 14, 1998). This is more in line with what some industry experts believe is the best methodology. Ritter and Barry both support the use of equipment lists in the initial planning stage and believe it is a far more accurate method than any use of percentage estimates.

Tenet does have standard percentage estimates for additional variables in the equipment budgeting process. Table 4 identifies these important variables in the equipment section as tax, freight, storage and installation. Again, the percentages were derived from evaluating historical projects and are updated as changes are revealed.

Both Columbia/HCA and Tenet manage projects centrally, and believe the methods they use have been accurate (typically within five percent for both organizations) and cite long project lead times and lack of centralized databases as the biggest obstacles for proper equipment planning in the military sector.

The Navy and Air Force equipment forecasting procedures for initial outfitting are similar to the Army in that both use a percentage of the PA to estimate costs. However, the similarities end there. Again, Table 1 shows the actual percentage estimates used by each service. In addition to the initial percentage estimates used by the Navy, Table 5 identifies the other variables used in its budgeting process. This worksheet is similar to Tenet's in that both take percentages of the estimated total for equipment to calculate additional estimates for each project variable. For example, all projects add 7% of the actual equipment costs to account for procurement assistance. These are often surcharges associated

Table 4  
**TENET HEALTHCARE CORPORATION**  
*Construction And Design Project Cost Estimate*  
 Facility: Tenet Hospital, Memphis, TN  
 Project No:

## 03. EQUIPMENT AND FURNITURE

## 01. Equipment

01. Cost		12,500,000	04. Storage	0.25%	31,000
02. Tax	6.4%	868,000	05. Install	1.49%	186,000
03. Freight	2.98%	372,000			

Sub-Total Equipment with Surcharges 13,957,000

## 02. Furniture

01. Cost	600,000	04. Storage 0.25%	1,500
02. Tax 7.00%	42,000	05. Install 1.50%	9,000
03. Freight 3.00%	18,000		

Sub-Total Furniture with Surcharges 670,500

## 03. Interior Design Items (Surcharges Included)

01. Accessory	15,000	05. Signage (Interior)	40,000
02. Artwork	5,000	06. Cubicles/Drapes/Blinds	100,000
03. Plants	5,000	07. Other/Interior Design	0
04. Carpets	0		

Sub-Total Interior Design Items 165,000

## 04. Exterior Signage

01. Exterior Signage	60,000
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## 05. Incinerator/Compactor/Sterilizer/Etc.

01. Incinerator/Compactor/Sterilizer/Etc.	0
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## 06. Telecommunications

01. Telephone System	275,000	05. Cable TV System	
02. Nurse Call	175,000	06. Central Dictation	75,000
03. Intercom	50,000	07. Cabling Allowance	50,000
04. Paging	50,000	08. Other/Telecomm	0

Sub-Total Telecommunications 750,000

## 07. Information Systems (Surcharge Included)

01. Pharmacy	100,000	05. Order Entry	100,000
02. Patient Accounting	100,000	06. Clinical Access	
03. Radiology	100,000	07. Cabling Allowance	100,000
04. Laboratory	100,000	08. Other/Info Sys	50,000

Sub-Total Information Systems 750,000

**TOTAL EQUIPMENT AND FURNITURE**

16,352,500

\*The information contained in this worksheet is fictitious and provided solely for educational purposes.

# COLLATERAL EQUIPMENT BUDGET PLAN

Project Location:

Millington, TN

Date:

6/5/1998

Project Number:

40102

Project Fiscal Year:

1998

Project Description:

Hospital

BOD (MM/YY):

10/1/2000

Project Cost (in thousands):

1,301

(All Amounts in \$ Thousands)

<u>FACILITY TYPE</u>	<u>Facility ID</u> (note 1)	<u>OM</u>	<u>OP</u>	<u>OM</u> <u>FY:</u>	<u>OM</u> <u>FUNDS</u>	<u>OP</u> <u>FY:</u>	<u>OP</u> <u>FUNDS</u>
Teaching Hospital	0	29%	3%	0	0.0	0	0.0
Hospital	1	22%	1%	2000	286.2	2000	13.0
Medical / Dental Clinic	0	17%	N/A	0	0.0	0	
Medical Clinic	0	17%	N/A	0	0.0	0	
Dental Clinic	0	16%	N/A	0	0.0	0	
BEQ/BOQ	0	15%	N/A	0	0.0	0	
Other	0	10%	NA	0	0.0	0	
Non Medical / APTU	0	7.50%	N/A	0	0.0	0	
					<b>286.2</b>		<b>13.0</b>

**SUBTOTAL - A (OM + OP)****299.2**

Overseas Cost	(Note 2)	0	2%	N/A	0.0
GOJ-FIP	(Note-3)	0	3%	N/A	0.0

**SUBTOTAL - B****286.2**

Procurement Assistance	(Note-4)	1	7%	N/A	20.0
Activation Cost	(Note-5)	1	1%	N/A	6.5

**TOTAL****312.8****13.0**

Note-1 Enter the number "1" for appropriate type of facility.

Note-2 2% of the Subtotal A amount due to voltage difference and procurement made from non-GSA/VA schedules.

Note-3 3% of the Subtotal A amount due to expected shifts of Category "A" to Category "C" equipment.

Note-4 7% of the Subtotal B amount for procurement assistance.

Note-5 .5% of the Project Cost.

with using various contracting activities. The Navy and Air Force use various contracting activities that demand a surcharge and view this as a worthwhile cost to have quicker procurement. The Army, however, does not utilize such agencies, which may explain the longer delays in procurement time.

The Air Force equipment forecasting process seems rather simplistic when compared to the other services and the civilian counterparts. As Table 1 points out, the Air Force estimates are significantly lower (e.g., only 19% for a replacement facility) than the others and facility type is not even a variable that is considered. Project type (i.e., replacement, addition/alteration) is the only variable taken into account during the planning stage. Anecdotally, the Air Force estimates are rarely accurate and often result in cutting corners and quantities to outfit the new facility within the initial budget estimate. Typically, the aesthetic items (e.g., artwork) are first on the chopping block.

Interestingly, equipment cost information by project was requested from both Air Force and Navy personnel for use in this analysis, but neither service had the data available in a useable format. In other words, the information is likely to exist in hard copy somewhere, but the ability to locate, sort and analyze it with any accuracy seemed rather unlikely, given manpower and time constraints, according to the service sources.



## Discussion

Table 2 highlights the key points of discussion in this study. On face value, the results indicate the exact *opposite* of predictions by the various service experts. In fact, the results show that on all but one project (i.e., BAMC), what was actually spent (ACTEQMT) was *less* than what was budgeted (PERCENT BUDGETED). However, the limitations of the study lead one to question the reliability of the data.

First, though the DoD contractor was involved in all of the equipment planning for these projects, they were not responsible for certain equipment categories on each project. For example, the contractor did not coordinate the computer requirements for the Womack Army Medical Center (WAMC) project or the furniture requirements for either WAMCE or BAMC. Therefore, since actual figures were not available, various sources (MRE database and the project Health Facility Planning Officer (HFPO)) close to the project were asked to provide an estimate of these costs. This methodology was used several times in similar instances of missing data. Furthermore, of the seven projects, two (WAMC and HAWA) were not completed at the time of data collection. In these instances, each project was determined to be a certain percentage complete (e.g., 90%) and the figures were adjusted accordingly. Both of these examples of handling missing data

point to the one recurring problem of having consistent data collection methods in place.

By far, the most significant study limitation that affects the results is the sample size. Though regression analysis would be the appropriate tool to ascertain the predictability of equipment costs, as a percentage of PA, seven projects is simply not enough to draw any relevant conclusions. In fact, this was the original intent of the study; however, the sample size prevented further analysis by this method. Unfortunately, data was only available in a useable format for these seven projects. The Army, like the other services, does not have detailed project data available in any organized manner for retrieval, unless, like in these particular projects, a civilian contractor was used for the equipment planning portion of the project.

Additionally, the Fort Sill project certainly requires further explanation because its estimated and actual spending figures appear to be the least aligned with the percent budgeted. With actual spending at 8.6% of the PA when the budgeting figure was 25%, even the contractor questioned the validity of the data. With large gaps in data such as this, no predictions, especially for the MEDDAC facility type, can possibly be made.

One point of discussion as a result of this analysis was what historical figure, estimated or actual equipment spending,

should be used as the budgeting or planning figure for future projects? For determining budget accuracy, it is easy to look at actual spending patterns by project, which can be found in Table 2. However, if planning the budget for a new MEDCEN, should the actual historical figure be used or the estimated figure?

For example, in Table 2, the two figures in question would be 34.5% as the MEDCEN weighted average for estimated equipment costs and 26.7% as the MEDCEN weighted average for actual equipment costs. Recall that the difference between the two is the theoretical cost avoidance that occurs by moving existing equipment from the old facility to the new one. Certainly, it would be wiser to plan with the higher, or estimated equipment figure, since the amount of equipment that will actually be reutilized is unknown. Furthermore, the estimated equipment figure may allow for more leeway or cushion in the event additional spending is required.

#### Recommendations and Conclusion

Though the limitations of this study seem to raise more questions than answers, it is important to recognize that negative results are often what are needed to inspire change in an organization. Clearly, this study reveals the inherent flaws in the data collection methodology utilized by the Army during initial outfitting. Since it appears that the systems and/or

centralization for project management at this level of detail do not exist, the Army MEDCOM should consider outsourcing all equipment planning functions on MILCON projects. If contracted with one agency, this would allow the application of consistent data collection methods across projects, which would result in easy data comparison and analysis.

Currently, the historical data is simply not available that would help make positive changes to the way projects are budgeted. Though the results do not point to severe overspending in initial outfitting, the manipulations and gaps in the data make one question the reliability and validity of the existing data.

Not surprisingly, the comparative analysis portion of the study reveals that this problem is pervasive in the MHS. All the services have similar problems in collecting comparable project data for analysis. Therefore, the first step for all the services must be to determine and standardize how project data is going to be collected. Until this is done, collecting the data is pointless because there is no commonality for comparison and analysis. The MHS has already made significant strides in accomplishing more with less in a tri-service atmosphere (e.g., GME training, tri-service formularies, etc). For the same reasons that these initiatives were started (i.e., cost savings and standardization), the MHS should pursue the

possibility of a centralized DoD contract for equipment planning. This has the great potential to alleviate many of the problems identified in this study.

Furthermore, it may be more accurate to determine the typical number of projects by facility and project type over a period of time and use that number as a sample size. As previously mentioned, the results indicated the Army was within their budgeted range on most projects, but the sample size of seven is not enough to make any real determinations about historical spending patterns or predictions about future budgets.

Though the results may be different than expected, the analysis should still be the impetus for action in the area of cost forecasting. Again, this will only come after proper procedures have been developed to collect reliable information.

The study objective to evaluate the other services' and private sectors' cost forecasting techniques revealed some interesting information that should be investigated. Tenet Healthcare and the Navy both include additional variables not currently used by the Army. Though the data is not available to prove that use of these variables increases the accuracy of the estimation process, it is certainly worth researching. It is always better to have equipment estimates higher than actual spending. The opposite situation leads to equipment shortfalls,

minimization of services and unhappy beneficiaries.

Overall, the services should be concerned, though probably not surprised, by the results of this study. The MHS cannot continue to involve itself in processes that have no reliable monitoring methods. Continuing on this path only serves to reinforce the MHS' image of having inappropriate spending patterns - an image often portrayed by the media. However, the MHS should be enlightened by the fact that the problems identified in this study are ones with relatively easy solutions. A clearly established policy and mechanism for capturing the data during initial outfitting can mean great strides in the budget process for future medical construction projects.

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Lieutenant Colonel Roberta Young, Deputy Chief, Health Facilities Division, Air Force Medical Support Agency (AFMSA), Office of the Surgeon General, Brooks Air Force Base, Texas.

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